MARCH, 1941.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

292. Structure of atomic nuclei. M. N. Saha, S. C. Sirkar and K. C. Mukherji. *Proc. Nat. Inst. Sci. India*, **6**, 1, *pp.* 45–63, 1940.—A chart has been drawn with *A*, the mass-number, as abscissa, *I*, the isotope number, which is defined as the excess of the number of neutrons over protons, as ordinate, and *Z*-lines at 45° to the abscissa or ordinate. In this chart all nuclei, stable as well as radioactive, have been represented with their abundance (for stable nuclei) and half-lives. The chart enables one to form a complete picture of all nuclei so far known, as well as of the nuclear processes. Rules of stability have been noticed; in the case of nuclei with even mass-number these have been partly foreshadowed by Bethe and Bacher; the rules for stability of odd nuclei which are noted here are believed to be new. A number of predictions are made regarding rare stable and radioactive nuclei. A number of anomalies in the present list of stable elements is pointed out. The mass-numbers of the U-fission product series to which Abelson assigned the values 132, 134, 136 are shown to be untenable. The correct mass numbers appear to be 131, 133, 135, respectively. Further, 2 series have been shown to possess the mass-numbers 141 and 143 respectively.

Authors.

293. Structure of the hydrides of B. J. Y. Beach and S. H. Bauer. *J. Amer. Chem. Soc.*, **62**, *pp.* 3440–3442, *Dec.*, 1940.—By means of an electron diffraction study the configuration of AlB_3H_{12} has been determined. The Al atom is bonded to 3 BH_4 groups at angles of 120° making the molecule planar except for the H atoms. The B atoms are located near the centre of trigonal bipyramids formed by the 4 H atoms of each BH_4 group and the central Al, $Al–B = 2{\cdot}14 \pm 0{\cdot}02$ Å; $B–H = 1{\cdot}27 \pm 0{\cdot}04$ Å. From the observed inter-atomic distances an electron configuration for the molecule was deduced.

Authors.

294. Isotopic weights of C and N by the doublet method. T. Asada, T. Okuda, K. Ogata and S. Yoshimoto. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 1684 (1940).]

295. Momentum distribution in molecular systems. I. The single bond. C. A. Coulson. **II. C and the C-H bond.** C. A. Coulson and W. E. Duncanson. **III. Bonds of higher order.** C. A. Coulson. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 55–81, *Jan.*, 1941.—A general discussion is given of the momentum wave functions of simple molecules in which only single bonds occur; the momentum functions are obtained by transformation of the space wave functions, for which 2 distinct approximations are possible. In each case it appears that the presence of the bond decreases the mean component of the velocity in the direction of the bond, increases the component perpendicular to the bond, and increases the mean momentum. The analysis is illustrated by consideration of H_2^+ and H_2.—The momentum distribution has been calculated for an electron in one of the hybridized orbitals of a C atom and is shown as a function of the degree of hybridization. The mean momentum shows a steady increase from pure *s* to pure *p* binding. Similar calculations have been made for the momentum distribution in the C–H bond, and it is shown that this also depends upon the degree of *s–p* mixing.—The discussion of momentum distribution is extended to cover electrons in double bonds and conjugated bonds of fractional order. The mean radial distribution function is obtained, and it shows that the mean momentum of the electrons is less than if they were rigidly attached to their own particular nuclei. Polar diagrams show that, if electronic mobility is high in any direction in a molecule, the momentum is generally small in that direction.

Authors.

296. Freedom of rotation about the C-C double bond. Certain substituted stilbenes. M. Calvin and R. E. Buckles. *J. Amer. Chem. Soc.*, **62**, *pp.* 3324–3328, *Dec.*, 1940.—It is shown that the same base is obtained upon half-reduction of both *cis* and *trans* isomers of 4,4′-dinitrostilbene. Two salts of this base have been prepared and it is suggested that they are the geometric isomers of the salts. It is demonstrated by spectroscopic means that the salts in acidified alcohol exist in both forms in comparatively rapid equilibrium with each other and that this equilibrium can be easily shifted by acid. The *cis–trans* equilibrium is maintained by virtue of the equilibrium between the ion and the base. The significance of the resonance phenomenon in understanding the effects of groups on the ease of rotation about a double bond is indicated. AUTHORS.

297. Normal vibrations of molecules of the $C(CH_3)_4$ type. S. SILVER. *J. Chem. Phys.*, **8**, *pp.* 919–933, *Dec.*, 1940.—For fixed orientations of the methyl groups there are 2 configurations in which the molecule as a whole possesses the symmetry group T^d. The group theory analysis has been applied to one of these configurations, referred to as the eclipsed form, and on the basis of Redlich's theorem a set of symmetry co-ordinates has been derived for each set of equivalent points. Every symmetry co-ordinate is associated with an irreducible representation of the group, and as a consequence, the secular determinant is factored to the maximum extent possible on symmetry considerations alone. Using a simple valence potential, the secular equations for the totally symmetric and doubly degenerate modes have been developed. Calculations have been made for $C(CH_3)_4$, $Si(CH_3)_4$ and $N^+(CH_3)_4$, assuming in every case that the force constants associated with the methyl groups are the same as in ethane. The results are in reasonable agreement with frequencies observed in the Raman spectra and a tentative assignment of the latter is suggested. AUTHOR.

COLLOIDS.

298. Electron diffraction study of hydrous oxides amorphous to X-rays. H. B. WEISER AND W. O. MILLIGAN. *J. Phys. Chem.*, **44**, *pp.* 1081–1094, *Dec.*, 1940.—Hydrous oxides amorphous to X-rays may be grouped in 2 classes: (*a*) oxides which give relatively sharp ring electron diffraction patterns and (*b*) oxides which give electron diffraction patterns of the amorphous type. The oxide gels of the first class are crystalline, but the size of the primary crystals is so small that their X-ray diffraction pattern consists of broad bands. The precipitated oxides of the following metals belong in this class: ferric iron, Al (from the sulphate), Ga, Ti (Ti^{IV}) and probably Be. The oxide gels of the second class are amorphous in the sense that glasses are amorphous, the atoms arranging themselves in the form of a network lacking the periodicity and symmetry which characterize a crystal lattice. The precipitated oxides of the following metals belong in the second class: Cr, Si, Cb (Cb^V) and Ta (Ta^V). The gel of ferric oxide thrown down at room temperature consists of minute crystals of α-Fe_2O_3. The oxide gel thrown down from $Al_2(SO_4)_3$ solution, like that from $AlCl_3$ or $Al(NO_3)_3$ solution, is γ-$Al_2O_3{\cdot}H_2O$. Ga gel precipitated at room temperature is composed of minute crystals of α-Ga_2O_3. AUTHORS.

299. Properties of thixotropic gels containing egg albumin as the disperse phase. W. G. MYERS AND W. G. FRANCE. *J. Phys. Chem.*, **44**, *pp.* 1113–1126, *Dec.*, 1940.—The explanation now given to account for the gel structures and the thixotropic breakdown and re-formation of the systems is a combination of the common theories of gel structure. A logical explanation of the elongation and solvation of the disperse phase to form anisometric lyospheres is given without postulating any unknown forces acting over large distances to account for the formation of solvated hulls. Thus the greatest weakness of the solvated-hull theory is avoided, while the interlocking of the lyospheres is not held solely responsible for the establishment of a gel structure, but a mechanism is described according to which the elongated lyospheres link together to form chains and 3-dimensional meshworks which entrap any of the dispersion medium not involved in the formation of the solvated hulls. The filaments making up the network are held to be highly solvated previous to their linking together, instead of simply being the disperse phase alone. Further, the repulsion-attraction equilibrium theory has been modified by postulating that added salts decrease the repulsion between the like-charged particles of the disperse phase which have already become highly solvated before the salt is added. The salt is then thought to decrease the repulsion between the elongated lyospheres to the extent that they can cohere enough so as to permit them to link together by the formation of hydrogen bonds among the molecules of the interpenetrating solvated hulls. H. H. HO.

300. Time of set of silica gels. V. Effect of alcohols and *p*H on heat of activation. L. A. MUNRO AND J. A. PEARCE. *J. Phys. Chem.*, **44**, *pp.* 1024–1033, *Dec.*, 1940.—Calculations of the so-called heat of activation have been made for silica gels over a *p*H range. The presence of addition agents does not essentially change the slope of the curve for acid gels. For acid gels the values for the heat of activation were the same as those obtained by Hurd. For alkaline gels the slope changes and finally a straight line is no longer obtained. The generalized curve relating *p*H and percentage effect on the set for a series of alcohols is given for the temperatures studied. It is concluded that the gelations of acid and alkaline gels are fundamentally different. AUTHORS.

301. Nature of foam. VII. Foam formation of mixed aqueous solution of saponin and ethyl alcohol. T. SASAKI. *Bull. Chem. Soc. Japan*, **15**, *pp.* 449–454, *Oct.*, 1940.—[See Abstr. 3912 (1939).] The foam formation of a mixed aqueous solution containing saponin in constant amount and

ethyl alcohol in varying concentration was studied. The life of foam produced (conc. being 0·009 085 g./l. and 0·001 820 g./l.) is remarkably lengthened by the addition of alcohol within the region of concentration from 0·002 6 mol./l. to 0·77 mol./l. Addition of alcohol in conc. exceeding 0·77 mol./l. again renders the foam unstable. Foam and hydrosol are compared with respect to their properties as disperse systems.
Author.

*302. **Electrically driven magnetically supported vacuum-type ultra-centrifuge.** C. Skarstrom and J. W. Beams. *Rev. Sci. Instrum.*, **11,** *pp.* 398–403, *Dec.*, 1940.—The electric motor drive and magnetic support for the vacuum-type ultra-centrifuge [Abstr. 902 (1939)] have been revised and improved. The drive is a 2-phase motor and the support a solenoid which attracts a solid steel cylinder fastened to the rotating parts. The armature of the motor consists of a solid steel cylinder and a magnetic core support mounted co-axially on a stainless steel tubular shaft. Cooling water passes through the tubular shaft. A 2-phase salient-pole stator produces the rotating magnetic field when actuated by the output of a transitron oscillator and power amplifier. Condensers in series with the motor field windings split the phase and match the load to the power amplifier. When the desired operating speed has been reached, a slip speed control actuated by a magnetic pick-up on the centrifuge shaft sharply reduces the power input to the motor and automatically holds the rotational speed constant to within 0·05%. When the slip is not too large, the mechanism provides a satisfactory ultra-centrifuge drive.
Authors.

*303. **Reflecting mirror optical system for the ultra-centrifuge.** W. G. France and E. R. Lang. *Rev. Sci. Instrum.*, **12,** *pp.* 32–34, *Jan.*, 1941.—An inexpensive optical system suitable for use with an air-driven ultra-centrifuge is described. Sedimentation pictures of inorganic colloid systems indicate the quality of sedimentation pictures possible with this apparatus.
Authors.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

304. **Stability of crystal lattices. V. Experimental evidence on recent theories of the equation of state and the melting of solids.** R. Fürth. *Proc. Camb. Phil. Soc.*, **37,** *pp.* 34–54, *Jan.*, 1941.—A short survey of Born's theory of the thermodynamics and melting of crystals is given. It is shown that Lindemann's and Grüneisen's law for the normal melting temperature can be deduced from this theory, and that the dependence of the melting temperature on pressure, and of the compressibility and the elastic constants on pressure and temperature, as predicted by the theory, are in good agreement with experiment. Several connections between breaking and melting, suggested by the fundamental ideas on melting and stability of crystals, are discussed and verified. Finally, a relation between the heat of melting and the heat of sublimation is deduced and compared with experiment. [*See* Abstr. 2882 (1940).]
Author.

305. **Thermodynamics and the structure of matter.** A. R. Ubbelohde. *Nature, Lond.*, **145,** *pp.* 488–491, *March* 30, 1940.—The author considers the lattice energy and shows how this may be calculated from the Clausius-Clapeyron equation and Hess's law; other contributions to the lattice energy are due to thermal vibrations. The paper briefly mentions the theoretical work involving the Dulong and Petit law and Debye's theories. Calorimetric results are used in the theories of crystal structure and in the calculation of equilibrium constants. Departures from the Nernst heat theorem are interpreted by a knowledge of the crystal structure.
E. H. D.

306. **Hydrothermal and X-ray studies of the garnet-hydrogarnet series and the relationship of the series to hydration products of Portland cement.** E. P. Flint, H. F. McMurdie and L. S. Wells. *Bur. Stand. J. Res. Wash.*, **26,** *pp.* 13–33, *Jan.*, 1941.—Isometric tricalcium aluminate hexahydrate, one of the well-established products of hydration of Portland cement, forms complete solid solutions with the corresponding ferrite, $3CaO \cdot Fe_2O_3 \cdot 6H_2O$, with grossularite garnet, $3CAO \cdot Al_2O_3 \cdot 3SiO_2$, and with andradite garnet, $3CAO \cdot Fe_2O_3 \cdot 3SiO_2$. Members of this solid-solution series were synthesized by hydrothermal methods, and X-ray determinations were made of their crystal structures. To the series belong: (1) The mineral plazolite, $3CaO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$, (2) the major product of hydration of the glass phase in Portland cement clinker at elevated temperatures and pressures, and (3) one of the major products of hydration of tetracalcium aluminoferrite.
Authors.

307. **Effect of heat treatment and cooling rate on the microscopic structure of Portland cement clinker.** G. W. Ward. *Bur. Stand. J. Res. Wash.*, **26,** *pp.* 49–64, *Jan.*, 1941.—Ten commercial Portland cement clinkers with their slowly and quickly cooled counterparts were examined microscopically. Methods are given for the conduction of the microscopical examination. The appearance of the clinker phases after the different heat treatments is described and the structure of the clinkers discussed. In general, for all clinkers, the phase compositions as calculated with consideration of glass agreed better with the microscopically determined phases than did those

based upon the calculations in which complete equilibrium crystallization was assumed. The microscopically determined $3CaO{\cdot}SiO_2$ was nearly always greater and the $2CaO{\cdot}SiO_2$ lower than that calculated by either of the other methods. The $3CaO{\cdot}Al_2O_3$ was always less than that calculated from chemical analyses. Generally, the $4CaO{\cdot}Al_2O_3{\cdot}Fe_2O_3$ found microscopically exceeded that calculated by either of the other methods. The glass determined microscopically and the values obtained from the heat of solution method agreed better for slowly and plant cooled than for quickly cooled clinkers. AUTHORS.

308. Crystallization phenomena in raw rubber. L. R. G. TRELOAR. *Trans. Faraday Soc.*, **37**, *pp.* 84–97, *Feb.*, 1941.—The process of crystallization in raw rubber held at various extensions at 0°C. has been studied by following the accompanying changes in double refraction and in density. It is concluded that a very low extension produces a relatively high degree of orientation of the axes of the crystallites in the direction of the extension. From 100% extension to the breaking-point the increase in birefringence with elongation is due almost entirely to an increase in the amount of crystalline rubber present; over this range the birefringence therefore gives a quantitative measure of the amount of crystallization. From the study of birefringence at 25° and 50°C. it appears that crystallization sets in rather rapidly at a certain intermediate elongation and then increases continuously up to the breaking-point. The observed changes in crystallization show a close correlation with the plastic-flow and elastic-recovery phenomena. AUTHOR.

309. Crystal structures of heterocyclic organic compounds of analogous constitution. I. R. G. WOOD AND J. E. CRACKSTON. II. R. G. WOOD, C. H. MCCALE AND G. WILLIAMS. III. R. G. WOOD AND G. WILLIAMS. *Phil. Mag.*, **31**, *pp.* 62–80, *Jan.*, *and pp.* 115–122, *Feb.*, 1941.—Thianthren (diphenylene disulphide I) and selenanthren (diphenylene diselenide II) are examined crystallographically, optically and by X-ray diffraction (rotation, oscillation and Weissenberg photographs). They are found to be isomorphous, being monoclinic, and having the space-group $P2_1/a\,(C_{2h}^5)$. The lattice dimensions are: for thianthren, $a = 14{\cdot}4$ Å, $b = 6{\cdot}11$ Å, $c = 11{\cdot}9$ Å and $\beta = 110°\ 0'$; and for selenanthren, $a = 14{\cdot}5$ Å, $b = 6{\cdot}24$ Å, $c = 12{\cdot}1$ Å and $\beta = 110°\ 20'$. There are 4 molecules in the unit cell. Optical examination shows the crystals to be biaxial and positive, and from their optical and magnetic properties a possible structure, possessing a non-planar molecule, is deduced.—Phenthiazine, Phenoxthionine, phenoxselenine and phenoxtellurine are found to be isomorphous, being orthorhombic; phenthiazine having the space-group $Pbn(C_{2v}^9)$ or $Pbnm$ (D_{2h}^{16}), and phenoxthionine, phenoxselenine and phenoxtellurine the space-group $P2_12_12_1$ (D_2^4). The lattice dimensions are: for phenthiazine, $a = 5{\cdot}91$ Å, $b = 7{\cdot}90$ Å and $c = 21{\cdot}0$ Å; for phenoxthionine, $a = 5{\cdot}94$ Å, $b = 7{\cdot}76$ Å and $c = 20{\cdot}5$ Å; for phenoxselenine, $a = 5{\cdot}93$ Å, $b = 7{\cdot}85$ Å and $c = 20{\cdot}5$ Å; for phenoxtellurine, $a = 5{\cdot}97$ Å, $b = 8{\cdot}16$ Å and $c = 20{\cdot}5$ Å. There are 4 molecules in the unit cell. All 4 crystals are found to be biaxial and positive. Optical and magnetic measurements lead to one possible structure for phenthiazine [illegible] another for the other 3 crystals.—An account is given of crystallographic, optical and X-ray measurements on phenazine and diphenylene dioxide. It is shown that the results for these substances imply that the phenazine molecule is plane, consistent with the molecule of diphenylene dioxide being plane. J. T.

310. Crystalline behaviour of linear polyamides. Effect of heat treatment. C. S. FULLER, W. O. BAKER AND N. R. PAPE. *J. Amer. Chem. Soc.*, **62**, *pp.* 3275–3281, *Dec.*, 1940.—X-ray studies of unoriented polyhexamethylene sebacamide and adipamide which have been solidified from melts at different rates demonstrate that the degree of polycrystallinity as well as the perfection of the crystal lattice is dependent on the rate of cooling. Annealing completely quenched specimens (both oriented and unoriented) restores the crystalline lattice arrangement in an amount which increases with the annealing temperature. The macromolecular behaviour has been related to that of ordinary monomeric systems. Parallel with the X-ray results a continuous increase in Young's modulus with decreasing rate of cooling from the melt is observed, indicating an increased degree of crystallinity. Both the X-ray and mechanical data are considered in terms of the segment theory of chain polymers. AUTHORS.

See also Abstract 392.

DENSITY.

311. Comparison of the density of water from different localities. K. GOTO AND K. OKABE. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. C*, **7**, 1939. *In German.*—[Abstr. 2311 (1940)].

312. Oxygen exchange between anions and water. N. F. HALL AND O. R. ALEXANDER. *J. Amer. Chem. Soc.*, **62**, *pp.* 3455–3462, *Dec.*, 1940.—Extensive density measurements by the method of the magnetically controlled swimmer have been carried out with a routine precision of 0·02 γd and an overall reproducibility (including the purification of samples) of 0·1 γd. Attention is called to the advantage, in comparing the densities of waters or dilute aqueous solutions, of working near the temperature of maximum density of the samples. Oxygen exchange between anions and water enriched in O^{18} was studied at 95–100° in the case of 21 inorganic salts and CrO_3. Resistance to exchange was found to increase toward the upper r.h. corner of the periodic table and with the number of oxygen atoms attached to a given central atom. Many of the exchanges appear to be promoted by excess acid and retarded by excess base. Most of the salts studied exchange completely under the conditions used, several show no exchange at all, and only a few show partial exchange. AUTHORS.

313. Measurement of the excess weight of air oxygen by exchange with inorganic salts. O. R. ALEXANDER AND N. F. HALL. *J. Amer. Chem. Soc.*, **62**, *pp.* 3462–3464, *Dec.*, 1940.—A method is described for determining the density difference due to oxygen alone of 2 samples of water. This consists in causing them successively and completely to exchange oxygen with a dissolved oxygen compound which contains no hydrogen. AUTHORS.

DIFFUSION AND OSMOSIS.

314. Separation by thermal diffusion of mixtures of gases having the same mol. wt. F. T. WALL AND C. E. HOLLEY, JR. *J. Chem. Phys.*, **8**, *pp.* 949–953, *Dec.*, 1940.—Six pairs of gases were considered, namely: CO_2-C_3H_8, CO_2-N_2O, N_2O-C_3H_8, CO-C_2H_4, CO-N_2, and N_2-C_2H_4. The experiments were carried out in a thermal diffusion column 274 cm. long. Assuming the molecules to behave as rigid elastic spheres, theoretical calculations were made for the various combinations and the results compared with the experiments. Except for the pair CO_2-N_2O, the theory and experiment agree as to order of magnitude and direction of separation. AUTHORS.

315. Effect of gravitational field on the thermal diffusion separation method. M. FARBER AND W. F. LIBBY. *J. Chem. Phys.*, **8**, *pp.* 965–969, *Dec.*, 1940.—A test of the effect of gravitational field on the operation of the Clusius-Dickel thermal diffusion method for gas separation has been made by use of a hollow disc with one hot surface, the whole disc spinning at various speeds. Linear increases in both the equilibrium separations and the rates of separation with increasing centrifugal force were obtained for speeds below a certain maximum value. Above this both the rate and equilibrium separations fell rapidly. He-CO_2 mixtures were used. The results indicate that the standard column would be improved if it were placed in a larger field up to 10 times that caused by gravity. Theories for the action of the thermal diffusion column should show this. The apparatus cannot compete with the standard column type for isotopic separations but may have some application to industrial separation problems. AUTHORS.

ELASTICITY AND PLASTICITY.

316. General bi-harmonic analysis for a plate containing circular holes. A. E. GREEN. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 29–33, *Jan.*, 1941.—This note shows that a simple extension of the analysis of a previous paper [Abstr. 2739 (1940)] leads to the solution of problems of generalized plane stress in an infinite plate containing circular holes of varying sizes arranged in any manner when the force resultants on each hole are not zero. The work can be adapted for plates bounded by 1 straight edge or by 2 parallel straight edges, but the analysis in the general case becomes too complicated and is not given. AUTHOR.

317. Measurement of period of natural vibration of an airscrew blade. J. OBATA AND Y. YOSIDA. *Rep. Aero Res. Inst. Tokyo, No.* 191, *pp.* 99–108, *July*, 1940.—[Abstr. 168B (1941)].

HYDRODYNAMICS AND AERODYNAMICS.

318. Flow of compressible fluid past circular cylinder. K. TAMADA AND Y. SAITŌ. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 3877 (1939).]

319. Flow of compressible fluid past sphere. K. TAMADA. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 1394 (1940).]

320. Application of the hodograph method to the flow of a compressible fluid past a circular cylinder. K. TAMADA. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 2006 (1940).]

321. Application of the similarity theory of turbulence to the flow through a straight pipe of annular cross-section. S. TOMOTIKA, K. TAMADA AND Y. SAITŌ. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 3068 (1940).]

322. Velocity distribution in turbulent flow through a straight pipe of annular cross-section. S. TOMOTIKA AND I. IMAI. *Rep. Aero. Res. Inst. Tokyo, No.* 180, *pp.* 301–322, *July*, 1939. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[See Abstr. 3068–70 (1940)]. The distribution of mean velocity is discussed theoretically on the basis of both the modified vorticity transport and the momentum transport theories of turbulent motion. It is assumed that the turbulence is isotropic and that the mixing length is proportional to the distance from the inner wall in the case of the inner region, whilst in the outer region it is proportional to the distance from the outer wall.

The calculated results are compared with the results of Mikrjukov's recent experiments. It is found that the modified vorticity transport theory gives better result. Authors.

323. **Flow between smooth parallel walls and through smooth pipe.** T. Okaya. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, 7, 1939.—[Abstr. 1715 (1940).]

324. **Effect of boundary walls of a stream upon the circulation round a plane aerofoil.** S. Tomotika, K. Tamada and Y. Saitô. *Rep. Aero Res. Inst. Tokyo, No.* 182, *pp.* 365–394, *Aug.*, 1939. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, 7, 1939.—The interference effect is discussed, when the aerofoil is placed in a semi-infinite stream bounded by a plane wall on the lower or upper side of the aerofoil and also when it is placed between 2 parallel rigid walls. The variation of the lift is due to the variation of the circulation round the aerofoil. The applicability of the method of images to the problem is discussed. Authors.

LENGTH, AREA AND VOLUME.

See Abstract 387.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

325. **Complementary functions of modified Bessel functions.** T. Okaya. *Proc. Phys.-Math. Soc., Japan*, 21, *pp.* 287–298, *June*, 1939. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, 7, 1939.

326. **Some characterizations of Euclidean space.** S. Kakutani. *Jap. J. Math.*, 16, 4, *pp.* 5–7, 1939. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. A*, 7, 1939.

327. **Method of calculating probability by means of the differential operator.** M. Nakagami. *Nippon Elect. Commun. Engng, No.* 21, *pp.* 28–34, *July*, 1940.—[Abstr. 31B (1941).]

328. **Solutions of Mathieu's equation.** J. G. Brainerd and C. N. Weygandt. *Phil. Mag.*, 30, *pp.* 458–477, *Dec.*, 1940.—[Abstr. 242 B (1941)].

329. **Lamé functions.** A. Erdélyi. *Phil. Mag.*, 31, *pp.* 123–130, *Feb.*, 1941.

MECHANICS, CLASSICAL.

330. **Problem in attractions and functions orthogonal to harmonic functions.** R. Wavre. *Arch. Sci. Phys. Nat.*, 22, *Suppl. No.* 2, *pp.* 113–115, *July–Aug.*, 1940. *In French.*—It is proved that there exist continuous distributions of matter in a domain, which have different arrangements of density but which yet have the same potential outside the domain and also the same inertial tensors. The density functions of these distributions are proved to be functions orthogonal to all harmonic functions of summable square. G. C. McV.

331. **Theory of a system of receding particles having a tendency to approach the central mass.** D. N. Moghe. *Proc. Nat. Inst. Sci. India*, 6, 2, *pp.* 225–235, 1940.—Milne's cinematical theory is extended to a system of receding particles in a slightly inhomogeneous space with a dense cluster at the centre of the sphere $r = ct$. This system has, therefore, a tendency to approach the central mass due to the mutual attraction. Equations of motion are obtained for this new system of particles from the principle of least action. The attraction towards the nuclear cluster is also evident from the relation $\rho_0 > \rho$, where ρ is the radius of curvature of the space for the new system and ρ_0 is that for Milne's case. Consideration of the energy equation for this system leads to a negative value for the energy function from which it can be surmised that this must be due to the tendency of approach towards the central cluster. As an example, a system of charged particles conforming to the extended theory is considered. Author.

332. **Deformability of a body whose potential is constant.** R. Soudan. *Arch. Sci. Phys. Nat.*, 22, *Suppl. No.* 2, *pp.* 79–82, *July–Aug.*, 1940. *In French.*—It is proved that an infinitesimal internal deformation of a homogeneous body is possible without altering its external potential (as measured beyond a certain critical distance from the body) by more than an infinitesimal amount of higher order than that of the deformation itself. G. C. McV.

333. **Rocket flight to the Moon.** J. W. Campbell. *Phil. Mag.*, 31, *pp.* 24–34, *Jan.*, 1941.—The method of rocket flight is considered by which the observer travels in the main body whose motion is controlled by the firing off from it of rockets. The alternative method, where the observer travels in the fired rocket, is discarded as being fatal to the observer. It is calculated that, even under the most favourable circumstances, the initial rocket would have to be about as massive at Mt. Everest, assuming that the observer wished to return to the Earth. G. C. McV.

MECHANICS, QUANTUM.

334. **Einstein's distant parallelism and Dirac's equation.** H. W. Haskey. *Phil. Mag.*, 30, *pp.* 478–486, *Dec.*, 1940.—It is shown that the matrices employed by Tetrode to express Dirac's equation in curved space can be related to Eddington *E*-matrices by expressing the Tetrode matrices as inner products of the fundamental vectors of

an Einstein distant parallelism with a pentad of *E*-matrices. It is then shown how to derive the *E*-matrix form of Dirac's equation from the Tetrode form. Using 5-dimensional continua it is possible to establish Dirac's equation in an electromagnetic field without simply adding the electromagnetic potentials to the field-free form of the equation. G. C. McV.

335. Ethane-ethylene-hydrogen equilibrium. E. A. Guggenheim. *Trans. Faraday Soc.*, 37, *pp.* 97–105, *Feb.*, 1941.—The equilibrium constant K_p for the reaction $C_2H_4 + H_2 \rightleftharpoons C_2H_6$ has been calculated by the methods of statistical mechanics. In the calculation use is made of spectroscopic data (Raman and infra-red), of measurements of heat capacity and of a single measurement of the heat of reaction, but no use is made of any data relating to the equilibrium of the above reaction. The calculated values of K_p are compared with the experimental values of 4 workers extending over the range of temperatures 673°K. to 973°K. The agreement between calculation and experiment is complete. The results of the calculations as well as the smoothed experimental data can be represented accurately by formulae which are valid throughout the experimental temperature range 673°K. to 973°K. Author.

PRESSURE.

See Abstract 359.

RELATIVITY AND ETHER.

See Abstract 334.

SOLUTION.

336. Systems of sodium palmitate in organic liquids. R. D. Vold, C. W. Leggett and J. W. McBain. *J. Phys. Chem.*, **44**, *pp.* 1058–1071, *Dec.*, 1940.–Solubility curves have been determined over the whole range of temperature and composition for anhydrous sodium palmitate in each of the following solvents: palmitic acid, glycerol, diethylene glycol, isopropyl alcohol, nujol, and heptane. At sufficiently high temperatures the soap is completely miscible in all proportions with these solvents, but at lower temperatures anisotropic gels, liquid crystalline phases and wax-like or crystalline phases, are formed. The solubility depends on the internal pressure and polarity of the solvents, higher temperatures being required in the non-polar than in the polar liquids. No phase completely analogous to aqueous middle soap was found in any of the organic liquids studied. A phase resembling aqueous superneat soap was found with palmitic acid and glycerol, but not with the less polar solvents. Authors.

337. Equilibrium diagram of the system Ag-Zn. K. W. Andrews, H. E. Davies, W. Hume-Rothery and C. R. Oswin. *Proc. Roy. Soc. A*, **177**, *pp.* 149–167, *Jan.* 10, 1941.—The equilibrium diagram of the system Ag-Zn has been investigated by thermal, microscopic, and X-ray methods. This has enabled the following points to be established: (1) The depression of the freezing pt. of Ag by Zn is slightly greater than that produced by equal atomic percentages of In. This does not confirm the hypothesis of whole-number liquidus factors previously suggested by Hume-Rothery, Mabbott and Channell-Evans. (2) The solidus and liquidus curves for the β phase do not coincide at 50 atom. % of Zn as was proposed by Petrenko. The freezing range of the equi-atomic alloy is approximately 3½°. (3) The determination of phase boundaries by X-ray methods with quenched filings is unreliable for this class of alloy, and its limitations are discussed. Authors.

SURFACE PROPERTIES.

338. Theory of adsorption of gases on solids when the potential energy varies continuously over the surface. A. R. Miller and J. K. Roberts. *Proc. Camb. Phil. Soc.*, 37, *pp.* 82–94, *Jan.*, 1941.—In developing the theory of adsorption, taking into account the interaction between adsorbed particles, it has been usual to employ a physical model in which it is assumed that there is a fixed interaction energy between particles adsorbed on neighbouring sites on the surface. In this paper the differences between the behaviour of this model and that of actual surfaces are discussed by considering a 1-dimensional film in which the potential energy of a single adsorbed particle varies continuously and periodically with its position on the surface and in which there is a repulsive force between adsorbed particles, which varies with the distance between them according to an inverse power law. For such a physical model the variation of the heat of adsorption with the fraction of the sites occupied is considered in detail and it is shown in particular that there is much less difference between the behaviour of mobile and immobile films than is indicated by the earlier model in which a fixed interaction energy is assumed. These results are considered in connection with the interpretation of experiments on the adsorption of H on W. Authors.

339. Adsorption of vapours at solid surfaces and the change of surface electric potential. A. A. Frost and V. R. Hurka. *J. Amer. Chem. Soc.*, **62**, *pp.* 3335–3338, *Dec.*, 1940.—The change of surface electric potential of various surfaces as caused by the adsorption of vapours of inorganic and organic substances has been observed by 2 different methods. The first apparatus, making use of a vacuum-tube electrometer, gives direct qualitative observations of the effect. The second apparatus, using a vibrating electrode, potentiometer, amplifier set-up, yields quantitative observations of the change of potential with pressure of vapour. The observed potential changes vary from 5 to 500 mV. AUTHORS.

340. **Theoretical and experimental analysis of the capillary rise method for measuring the surface tension of solutions of electrolytes.** G. JONES AND L. D. FRIZZELL. *J. Chem. Phys.*, **8,** *pp.* 986–997, *Dec.*, 1940.—Jones and Ray made measurements of the capillary rise of solutions of electrolytes which they interpreted as showing that there is a minimum in the surface-tension/concentration curve at low concentration (about 0·001 *N*). Langmuir has suggested that the liquid film above the meniscus may be several hundred Ångströms thick and may be sufficiently different for water and for solutions of electrolytes to account for the observed capillary rises without drawing the conclusion that there is a minimum in the surface tension. Langmuir's theory is analysed in detail and one of its premises is shown to be inconsistent with experimental evidence of several kinds, which indicates that a solution/air interface is electrically charged. Langmuir's theory gives the thickness of the wetting film as an explicit function of the concentration and temperature of the solution, of the capillary rise (which depends on the radius of the tube and on the surface tension of the liquid), and of the ζ-potential. But ζ-potentials are not known with sufficient precision to permit reliable calculations of the thickness of the wetting film. Some of the consequences of the theory are tested experimentally. AUTHORS.

341. **Surface characteristics of cotton fibres as indicated by electrophoretic studies.** A. M. SOOKNE AND M. HARRIS. *Bur. Stand. J. Res. Wash.*, **26,** *pp.* 65–69, *Jan.*, 1941.—The surface characteristics of cotton fibres were investigated by a micro-electrophoretic technique. Samples of dewaxed cotton, cotton which had been depectinized by treatment with a boiling 1% solution of NaOH for various lengths of time, and pectic substance from cotton, gave widely different *p*H-mobility curves. The curve for pectic substance is characteristic of a highly acidic substance, whereas that for depectinized cotton shows a low order of acidity. The curve for dewaxed cotton appears to be a composite of the curves for cellulose and pectic substance. The purified cellulose exhibits a reversal of charge below *p*H 2·5, and accordingly is iso-electric at that *p*H. It is shown that the reversal of charge has not resulted from irreversible changes produced in the fibre during immersion in the dilute solutions of acid used in the present investigation. AUTHORS.

342. **Statistical theory of duplex films.** L. S. K. FENG AND W. BAND. *J. Chem. Phys.*, **8,** *pp.* 977–980, *Dec.*, 1940.—The dissociation treatment of condensing systems is applied to duplex films. Complete agreement with the data on the saturated state of the films of myristic acid published by Adam and by Harkins is obtained on the following assumptions: (i) the momentum of each entire molecule contributes to the monolayer gas pressure; (ii) the interaction potential between the liquid ends of the molecules is equivalent to an intrinsic pressure which has the effect of increasing the surface tension at the interface between parent liquid and monolayer; (iii) this intrinsic pressure is derivable from a Lennard-Jones type of interaction potential depending on mean molecular area: $W = W_0 + \alpha/A^{4\cdot5} - \beta/A^{8}$; (iv) the tails of the molecules can form clusters, thus forming micelles in the duplex film, in which there are 6 bonds/mol., each with interaction energy $\epsilon = 8\cdot8 \times 10^{-14}$ erg/mol. The field constants α, β seem to depend slightly on the nature of the parent liquid, but the energy ϵ is independent of this. The duplex film therefore appears to have its liquid layer in contact with the parent liquid, the free tails forming the gas layer. More data on different parent liquids are needed before a definite decision on this point can be made. AUTHORS.

343. **Film continuity of synthetic resin coatings. Accelerated film breakdown test.** G. H. YOUNG, G. W. GERHARDT, W. K. SCHNEIDER AND G. W. SEAGREN. *Industr. Engng Chem.*, **33,** *pp.* 72–74, *Jan.*, 1941.—Film continuity measurements can be used to follow progressive changes on storage or exposure to degrading influences only when the test film thickness approaches the minimum or threshold value for complete coverage. A method is presented for measuring quantitatively the relative resistance of continuous films to electrolytic attack. The expected sensitivity of the test to coating thickness is demonstrated. AUTHORS.

344. **Mechanism of boundary lubrication. I. Action of long-chain polar compounds.** O. BEECK, J. W. GIVENS AND A. E. SMITH. **II. Wear prevention by addition agents.** O. BEECK, J. W. GIVENS AND E. C. WILLIAMS. *Proc. Roy. Soc. A*, **177,** *pp.* 90–118, *Dec.* 31, 1940.—[Abstr. 145B and 146B (1941).]

345. **Studies in lubrication. IX. Effect of the pressure variation of viscosity on the lubrication of plane sliders.** M. MUSKAT AND H. H. EVINGER.

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J. Appl. Phys., **11**, *pp.* 739–748, *Nov.*, 1940.—[Abstr. 22B (1941).]

346. Electron diffraction study of the corroded state of metals. S. Yamaguchi. *Sci. Pap. Inst. Chem. Res. Tokyo, No.* 998, *pp.* 106–114, *Nov.*, 1940. [*See* Abstr. 1427 (1940).] There is a continuity not only between products obtained from reactions between metals and chemical reagents but also between the forms of diffraction patterns obtained; with K corroded by water, without retaining the ground metal, a much larger crystal was obtained than in the corrosion in ordinary air, and the same holds true for Na, Li, and Mg. Author.

See also Abstracts 419, 387.

VISCOSITY AND FRICTION.

∗ 347. Viscosities of common gases between 90°K. and room temperature. H. L. Johnston and K. E. McCloskey. *J. Phys. Chem.*, **44**, *pp.* 1038–1058, *Dec.*, 1940.—An apparatus based on that of Sutherland and Maass for accurate measurement of gaseous viscosities is described. The chief improvements from the point of accuracy are the introduction of a thermocouple soldered directly to the disc assembly and the use of a thermostatically controlled bath. The introduction of brass springs to hold the fixed discs in place and the removal of the hook and slotted eyelet to the bottom of the suspension wire increase the ease of assembling and operating the apparatus and of replacing the suspension wire. Variations were observed in the wire constant and are attributed to (1) work hardening of the metal and (2) the influence of glass working adjacent to the apparatus. Viscosities relative to air at 296·1°K. have been measured for hydrogen, air, oxygen, nitrogen, nitric oxide, nitrous oxide, carbon dioxide and methane. Viscosities were measured at intervals of 10–15 deg. K., from 90°K. to 300°K. Authors.

348. Determination of the viscosity by torsional vibration. T. Okaya and M. Hasegawa. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 3926 (1939).]

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

349. Perseid meteor shower, 1940. P. M. Millman. *J. Roy. Astr. Soc. Can.*, **34**, *pp.* 469–480, *Dec.*, 1940.—Work was planned for 5 nights, Aug. 9–14. A complete list of Perseid observations is given. The meteors were divided into Perseids and non-Perseids; plots are given for visual hourly rates; the maximum was on Aug. 11–12; fewer Perseids were seen than in 1939; there was a drop in Perseid rates about 2 a.m. in both years and on Aug. 13–14 in 1939. Tables are given of visual observations, magnitude distribution, spectrophotography and direct photography; also graphs of meteors per hr. As a whole the meteors photographed this year were fainter and less striking than those in 1939. A. S. D. M

COSMOGONY.

350. Origin of solar system. P. L. Bhatnagar. *Indian J. Phys.*, **14**, *pp.* 253–281, *Aug.*, 1940.—The paper deals with the tidal theories of the origin of the solar system. The author shows that in the 2-body problem there is no possibility for the formation of the planetary ribbon, from which the present planets are supposed to have been developed, by a close encounter or a grazing collision between two stars of usual masses. The theory extended by Lyttleton to explain the origin of planets is examined mathematically and it is proved that in the most favourable situation for the formation of the planetary ribbon in the 3-body problem, at the middle of the collision between the sun's companion and a visiting star, the sun would come so near to its companion, and hence to the visiting star, that a very close encounter or collision between them could hardly be avoided. Author.

STARS.

351. Radiation pressure and energy flux in stellar interiors. G. Tiercy. *Arch. Sci. Phys. Nat.*, **22**, *Suppl. No.* 2, *pp.* 56–59, *July–Aug.*, 1940. *In French.*—Eddington's theory of stellar constitution implies that the energy flux reaches its maximum about half-way from the centre of the star to the surface so that the flux in the outer parts of the star is sensibly constant. This feature of the theory has been criticized by Sevin who suggests that the flux should increase with the radius from the centre to the surface. It is shown that the latter hypothesis is not in accord either with the assumption of radiative equilibrium or with polytropic structure characterized by $n=3$. Eddington's theory, on the other hand, does agree with these conditions. G. C. McV.

352. The numerical factor k_1 in Eddington's formula for the luminosity *L*. G. Tiercy. *Arch. Sci. Phys. Nat.*, **22,** *Suppl. No.* 2, *pp.* 53–56, *July–Aug.*, 1940. *In French.*—It is known that the absorption coefficient deduced by comparison of Eddington's mass-luminosity formula with the data furnished by Capella is 10 times greater than the theoretical value. Eddington's calculation is defended on the grounds that conditions in the stellar interior are too obscure to permit certainty of whether or not the assumptions on which the theoretical value are based are fulfilled. G. C. McV.

353. Selective absorption of light in interstellar space. A. Hunter. *Nature, Lond.*, **147,** *pp.* 152–153, *Feb.* 1, 1941.—From the amount of selective absorption suffered by the light of stars at various galactic longitudes a lower limit to the total absorption is deduced. In early-type stars little of the reddening can be due to a luminosity effect, and recent work has attributed it all to space absorption ; hence upper limits can be found for the distances of such stars. From the distribution of reddening with respect to galactic longitude and distance it is concluded that there is an irregular stratum of dust particles confined to within a few hundred parsecs of the plane of the galaxy and extending to at least 2000 or 3000 parsecs from the sun. The size of the dominant particle is about the wavelength of visible light. Superposed on this stratum there are the galactic nebulae and dark obscuring clouds containing larger particles producing non-selective absorption. The effects of these two sources combine to reduce, by a factor of 2 or more, the diameter previously assigned to our stellar system. A. Hu.

354. New method for the photographic observation of double stars. F. Henroteau. *J. Roy. Astr. Soc. Can.*, **34,** *pp.* 456–464, *Dec.*, 1940.–The method causes the exposure to be stopped as soon as the image of the primary star is slightly displaced from normal position through variations in R.A. and Dec. The perfect photographic images are analysed by means of a thermo-electric or photo-electric slit-photometer so as to get photogrammetric curves for accurate position angles and angular distances. The photo-electric cell causes an electro-optic shutter to open when the max. starlight strikes the cell and to be immediately and completely closed as soon as a little less than the max. starlight strikes the cell. The device is adjusted so that only with perfectly calm atmosphere, that is with sharp definition of the hole in front of the cell, will the grid allow all the electrons to go through the microscope. A. S. D. M.

355. Galactic and extragalactic studies. XI. Note on the period frequency of galactic Cepheids. H. Shapley. *Proc. Nat. Acad. Sci., Wash.*, **26,** *pp.* 681–688, *Dec.*, 1940.—[See Abstr. 68 (1941).]—The correlation found in the Small Magellanic Cloud between the periodicity of classical Cepheids and the star density in their neighbourhood is confirmed also in our own galaxy. Five rich variable-star fields near the galactic centre are investigated : in these only long-period Cepheids are found. An examination of the periods, magnitudes and longitudes, of all the 340 known galactic Cepheids confirms the conclusion that the long-period Cepheids occur preferentially in regions of high star density and high gravitational potential. A. Hu.

SUN.

356. Spectrographic observations at the total solar eclipse of 1940, October 1. R. O. Redman. *Observatory*, **63,** *pp.* 307–311, *Dec.*, 1940.—The instruments used for observations at Calvinia are described. G. C. McV.

357. Apparent influence of the Earth on solar prominences. A. K. Das and B. G. Narayan. *Indian J. Phys.*, **14,** *pp.* 311–323, *Aug.*, 1940.—A statistical study has been made of Kodaikanal observations of solar prominences during the period 1913–37 and it has been found that the annual variations of the mean daily areas, the mean daily heights and of the mean daily bases of prominences at the limb, correspond to the variation of the Earth's distance from the Sun in the course of the year. In particular, it has been found that the max. of the mean daily area at perihelion and the min. at aphelion differ from each other by about 9·6 % of the max. This has been shown to be evidence of the existence of a terrestrial influence on solar prominences. The effects of planets other than the Earth have also been examined and it is concluded that they cannot be appreciable. It is tentatively suggested that the observed influence of the Earth on prominences may well be the result of a tide-raising force which varies inversely as the cube of the distance between the Earth and the Sun. Authors.

See also Abstract 370.

GEOPHYSICS.

GEODESY.

358. Second approximation in the calculation of the Earth's ellipticity. J. Ruffet. *Arch. Sci. Phys. Nat.*, **22,** *Suppl. No.* 2, *pp.* 115–117, *July–Aug.*, 1940. *In French.*—Wavre's method of uniform procedure in theoretical geodesy is used to calculate the ellipticity of the Earth to the second approximation. All relevant functions and, in particular, the polar radius and the mass of the Earth are expanded as power series of the angular velocity. The most probable value for the ellipticity is 1/296, though the values 1/295 and 1/297 are also compatible with the calculated results. G. C. McV.

LAND, PHYSICS OF THE.

359. New theories and concepts in analytic soil mechanics. J. H. A. Brahtz. *Min. Mag.*, **30,** *pp.* 635–638, 656–657 *and* 661, *Dec.*, 1940.—It is shown that the final problem in analytic soil mechanics is similar to the elastic problem, viz. the estimation of stresses and displacements under given load conditions. The paper deals with (i) concepts and stress definitions, criteria of stability, boundary conditions; (ii) pore pressures and their magnitude and time rate of dissipation under known boundary conditions, consolidation without percolation, time consolidation accompanied by percolation, construction period during which pore pressures will build up to magnitudes depending on the physical constants of the soil, the geometry and drainage of the structure and the rate of construction, full reservoir in which existing pore pressures are determined as the steady state which would exist after a long period, reservoir draw-down, where the critical region occurs near the upstream face; (iii) displacements in soil structures, which are functions of the contact stresses and depend on the existing pore pressures. A Bibliography of 23 publications completes the paper. H. H. Ho.

METEOROLOGY

360. Wind force and exceptional visibility at sea. I. R. Tannehill. *Mon. Weat. Rev., Wash.*, **68,** *pp.* 211–213, *Aug.*, 1940.—$5 \cdot 5 \times 10^6$ ship observations obtained during 50 years were available for use. In the Pacific north of 20° N the range of vision decreases with increase of wind velocity for the range 8 to 16 knots. Exceptional visibility is less frequent for winds of force 1 or a calm than for force 2, but is again less frequent for higher wind forces. The range of horizontal visibility on the sea coast and over the open ocean is frequently reduced by the presence of a haze composed of microscopically small water droplets or very hygroscopic particles produced by the action of wind on the sea surface, the obscuration increasing with wind velocity. R. S. R.

361. Estimation of small quantities of CO_2 in air by the absorption of infra-red radiation. H. Dingle and A. W. Pryce. *Proc. Roy. Soc. B*, **129,** *pp.* 468–474, *Dec.* 31, 1940.—This paper describes an investigation of the possibility of measuring small amounts of CO_2 in air by the absorption of infra-red radiation. It is shown that the method is simple, trustworthy and accurate, and is very sensitive for small amounts of CO_2, of the order of that present in ordinary air. The principle is applied in a form superior to any hitherto used, in that the whole of the transmitted radiation is measured instead of merely the radiation at the maximum of a particular absorption band. This makes a spectrometer unnecessary, eliminates the disturbing effect of variation of temperature, and allows much less sensitive detecting apparatus to be used. The only preliminary treatment necessary is the removal of water vapour from the air under examination. Authors.

362. Geographic complex method for the study of climate. I. K. Tihomirov. *Mon. Weat. Rev., Wash.*, **68,** *pp.* 214–216, *Aug.*, 1940.—The general ideas of this method for the study of climate are presented together with a broad outline of a practical method of development. Changes in solar radiation and the relief of continents, with the distribution of land and water, mainly determine the climate, while man's action on the landscape has some modifying effect. The bearing of this is discussed. R. S. R.

SEISMOLOGY.

363. Form and nature of seismic waves and structure of seismograms. N. Ricker. *Geophysics*, **5,** *pp.* 348–366, *Oct.*, 1940.—It is demonstrated mathematically that a sharp seismic disturbance gives rise to a travelling wavelet of shape determined by the nature of the earth's absorption spectrum for elastic waves, and that a seismogram is composed of a succession of these wavelets, generally overlapping but sometimes in the clear. It is further brought out that it is the centre of the wavelet which travels with a velocity characteristic of the medium, and that the wavelet broadens as it moves along in accord with a definite law. Experimental support of the theory is also given. Author.

364. Changes in the Earth's magnetic field accompanying earthquakes or volcanic eruptions; 2nd and 3rd reports. Y. Katô. *Sci. Rep. Tôhoku Univ.*, **29,** *pp.* 315–342, *Nov.*, 1940.—[See Abstr. 4443 (1938).] The vertical intensity of the earth's magnetic field of the epicentral region of the Kuttyaro earthquake, May 29, 1938, was measured by Schmidt's field balance after the earthquake, and a close relation between the magnetic disturbance and the seismic activity was found.—At the Iwaki earthquake one of the most remarkable phenomena was that the damage was conspicuous only in the earth block from Namie to Sinzan and the local anomaly of the vertical component of the magnetic field is closely correlated to this block structure. Tunami was associated not only with the first earthquake but also with the following shocks. AUTHOR.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

365. Electricity of continuous rain. J. A. CHALMERS AND E. W. R. LITTLE. *Terr. Mag. Atmos. Elect.*, **45**, *pp.* 451–462, *Dec.*, 1940.—The observations were made at Durham, England, from 1300 hrs. on March 27 to 0600 on March 28, 1939, during a period of continuous rain due to the passage of a warm front. The clouds were fracto-nimbus with base at 250 m. Measurements were made at 10 min. intervals and revealed a marked parallelism between the point-discharge current and the rain-current. The former was negative for a total of 582 min. and positive for 2 min., whilst the latter was positive for 74 periods and negative for 16. A detailed discussion of these results shows that some but not all of them can be accounted for either on the theory of a negative cloud or on that of a bipolar cloud. G. C. McV.

366. Systematic ionospheric changes associated with geomagnetic activity. L. V. BERKNER AND S. L. SEATON. *Terr. Mag. Atmos. Elect.*, **45**, *pp.* 419–423, *Dec.*, 1940.—Systematic changes of max. ion density of the F_2 layer accompanying geomagnetic disturbances were investigated, using observational material from Watheroo and Huancayo collected during 1938 and 1939. Deviations from an arbitrary normal are computed. At Huancayo the max. increases continuously with magnetic activity up to (American) character-figure 2 · 0. At Watheroo this relation is reversed between September and April. In winter the density rises at slight or moderate magnetic activity and then falls as magnetic changes become severe. G. C. McV.

367. Ionospheric changes associated with the magnetic storm of March 24th, 1940. L. V. BERKNER AND S. L. SEATON. *Terr. Mag. Atmos. Elect.*, **45**, *pp.* 393–418, *Dec.*, 1940.—Observations of the ionosphere at Huancayo and Watheroo during the magnetic disturbance of March 24, 1940, are shown and discussed. At Huancayo the ionospheric disturbance began about 40 min. before the first large magnetic change, though coinciding with increasing magnetic activity. During the first great magnetic changes the F_2 layer was swept upward and disappeared in about 30 min. At the same time ion density of the E layer rose about 40%. Growth of a new F_2 layer began after disappearance of the old, proceeding in an apparently normal manner for the next hr. Because the original ion density had been reduced to a low value, the F_2 region is regarded as a nearly un-ionized atmosphere, suddenly exposed to solar radiation. Effective recombination coefficient and rate of ion production at level of maximum density of F_2 region are estimated from this growth. Steady growth of the new F_2 layer was followed by a succession of abnormal increases and decreases of ion density of diminishing amplitude at an almost regular period of 3 hr. for 3½ or 4 periods. Abnormal rate of decrease and subsequent increase of abnormal electron production at level of maximum is computed for the first period. At Watheroo ionospheric changes followed the general pattern usually experienced during magnetic disturbances in temperate zones. Evidence indicates large spatial tilts of iso-ionic surfaces near Watheroo about 40 min. after beginning of great magnetic changes. These spatial tilts were followed by rapid rise of height and increase of scattering. Abnormal decrease of ion density of the F_2 layer began simultaneously at both observatories, within observational limits, less than 15 min. after the first great geomagnetic change. The great rise in height at Watheroo lagged behind that at Huancayo by nearly 1 hr. AUTHORS.

368. Spherical harmonic analysis of the *Sq* variations, May-Aug., 1933. N. P. BENKOVA. *Terr. Mag. Atmos. Elect.*, **45**, *pp.* 425–432, *Dec.*, 1940.—The observations from 46 stations scattered over the globe were analysed assuming that (1) the field of the *Sq* variations was a function of time and of 2 spherical co-ordinates; (2) the *Sq* field could be analysed into 2 parts, one depending on local and the other on universal time; (3) this field has its origin both above and below the earth's surface. The main part of the *Sq* field was found to be external. The current systems of the F_1 and F_2 fields are drawn. The former is in good agreement with Chapman's system *C*. The external part of field F_2 was 1·7 times larger than the internal. G. C. McV.

369. Isomagnetic charts. I. Their singular points and contour-lines. II. The form and disposition of the nodal curves. S. CHAPMAN. *Terr. Mag. Atmos. Elect.*, **45**, *pp.* 433–450, *Dec.*, 1940.—Some aspects of the geometry of isomagnetic charts are considered, particularly as regards their ray-poles and singular points—foci and nodes. Special types of singular points are shown to include circular foci, rectangular nodes and cusps. Some suggestions are made regarding the construction of isomagnetic charts.—The form of the special isomagnetic lines which cross themselves (the nodal curves) is discussed, and the nature of the regions into which they divide the surface of the sphere. Geomagnetic illustrations of the simpler types of isomagnetic chart are cited. AUTHOR.

370. Time relation between solar emission and terrestrial disturbances. C. N. ANDERSON. *Proc. Inst. Radio Engrs, N.Y.*, **28**, *pp.* 503–511, *Nov.*, 1940.—Although the correlation between general solar activity and terrestrial disturbances is quite evident, the association of individual storms with specific sunspot groups has never been very satisfactory. Disturbances sometimes have occurred when no sunspots were visible and at other times large sunspots have been unaccompanied by any abnormal disturbances. A possible explanation of such anomalies may lie in longer transit times for the disturbing solar emission than is usually assumed. Some indication is given in this paper that these transit times may range from periods as short as only 1 or 2 days to as much as 3 months. The corresponding velocities for the above transit times are of the order of 2000 and 20 km./sec. Curves show the approximate relation between the angle of emission, velocity, day of emission, and the days intervening between the passage of a spot through the central meridian of the sun and the corpuscular encounter with the earth. AUTHOR.

See also Abstract 364.

RADIOACTIVITY.

371. Radium content of mineral springs in Japan. T. NAKAI. *Bull. Chem. Soc. Japan*, **15**, *pp.* 333–426, *Oct.*, 1940. *Suppt.*—A detailed investigation has been carried out of the radium content of 477 mineral springs and of 15 brine samples from oil fields in Japan, by comparing the radioactivity of the radon expelled from the sample with that produced by the radon from a known amount of radium. Results are given in tabular form, the geographical distribution being indicated on maps. The highest value found was $1\cdot1 \times 10^{-10}$ g./l., which compares unfavourably with the best value for the world of $1\cdot8 \times 10^{-8}$ g./l. in the North Caucasus. Detailed results are given for certain springs with attempts to correlate the radium and radon contents with other physical and chemical properties of the springs. The radium content of the sinter deposits of some springs has been measured and found to be of the order of 3×10^{-11} g./l. Finally, a convenient method of the extraction of radium from mineral springs is indicated. G. O. B.

372. Radiations from radioactive ^{65}Zn. Y. WATASE, J. ITOH AND E. TAKEDA. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 1502 (1940).]

373. Disintegration of ^{24}Na. S. KIKUCHI, Y. WATASE, J. ITOH, E. TAKEDA AND S. YAMAGUCHI. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 4276 (1939).]

374. β-ray spectrum of radio-chlorine. Y. WATASE AND J. ITOH. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 415 (1940).]

375. γ-ray of ^{13}N. Y. WATASE AND J. ITOH. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7**, 1939.—[Abstr. 3971 (1939).]

***376. Calibration of Neher-Harper counter circuit for accurate comparison of β- or γ-ray sources.** D. E. HULL. *Rev. Sci. Instrum.*, **11**, *pp.* 404–411, *Dec.*, 1940.—The conditions affecting the reproducibility of a thin-walled all-glass type counter used with the Neher-Harper quenching circuit have been investigated. The plate voltage and grid bias on the quenching tube are the most critical factors, and experimental arrangements for holding them constant are described. An upward drift in counting rate is noted at rates of the order of 100 per sec., and methods for minimizing the effect of this drift on the accuracy of the measurements are described. A new method of calibrating a counter circuit is used. The activity of a sample of radon is measured under the same geometrical conditions at different times and, by use of the accurately known half-life of radon, the counting losses at various speeds are determined. A variation of the multiple-addition method of calibration is also used, with concordant results. AUTHOR.

RADIATION.

COLORIMETRY.

377. Colour charactistics of cement. L. R. Dawson, R. V. Andes and T. D. Tiemann. *Industr. Engng Chem.*, **33,** *pp.* 95–98, *Jan.*, 1941.—A quantitative method for the determination and comparison of the colour characteristics of standard Portland and several special cements and other substances is described. It is based on measurements made with a Zeiss Pulfrich photometer. The colour or hue of the standard Portland cements investigated varies over relatively narrow limits from nearly neutral grey through yellow or tan to a reddish brown. The average reflectivity or lightness ranges from 15·0 to 35·1, as compared with a baryta plate as 100. This value for white cements is of the order of 75. Specific surface and ferric oxide content affect the average reflectivity. Increase in specific surface and decrease in ferric oxide content increase the average reflectivity or lightness. Apparently, a change in specific surface does not essentially alter the colour or hue. Authors.

378. Analysis of the original Munsell colour system. J. E. Tyler and A. C. Hardy. *J. Opt. Soc. Amer.*, **30,** *pp.* 587–590, *Dec.*, 1940.

379. Analysis of Munsell colour system based on measurements made in 1919 and 1926. K. S. Gibson and D. Nickerson. *J. Opt. Soc. Amer.*, **30,** *pp.* 591–608, *Dec.*, 1940.—An examination has been made of the Munsell colour system as it existed in 1919 and 1926, based on data derived from spectrophotometric measurements. The relation between Munsell value and luminous apparent reflectance, $V^2 = 100k\,(Y - 0{\cdot}007)$, has been confirmed. While there are large individual variations, the above relation, with k approximating to unity, adequately represents the data as a whole. The white point on this scale corresponds to magnesium oxide, the black point to a sample reflecting diffusely about 0·7%. The relation between Munsell Atlas hue and dominant wavelength depends upon the neutral (reference) point adopted. At best there are significant deviations from 1 : 1 correspondence. Therefore the terms for dominant wavelength and for Munsell hue as illustrated by the original papers of the Munsell system cannot be used interchangeably. A psychophysical system has been developed, based on the inverse CV weighting indicated in the Atlas instructions for a disc mixture to yield neutral grey. Authors.

380. Trichromatic analysis of the Munsell book of colour. J. J. Glenn and J. T. Killian. *J. Opt. Soc. Amer.*, **30,** *pp.* 609–616, *Dec.*, 1940.—

381. Preliminary report of the O.S.A. subcommittee on the spacing of the Munsell colours. S. M. Newhall. *J. Opt. Soc. Amer.*, **30,** *pp.* 617–645, *Dec.*, 1940.—The spacing problem consists in the detection and correction of errors of allocation in surface-colour space of the regular 1929 Munsell samples. This amounts to the adjustment of imperfections in a real chromatic skeleton of 400 units so that it will more properly fit into an ideal chromatic body. For the last 5 years various observers have been making visual estimates of the colour spacings, and the accumulated data have been summarized and are presented in tabular form. These data will provide a psychological basis for defining smooth contours of Munsell hue, value and chroma, in terms of the 1931 ICI colorimetric co-ordinate system. Author.

EMISSION.

382. Second maximum of the Rossi curve. N. N. Das Gupta. *Proc. Nat. Inst. Sci. India*, **6,** 1, *pp.* 65–72, 1940.—Cosmic-ray showers from Pb have been investigated with 3-fold coincidence arrangement up to a total thickness of 22 cm. of Pb. The min. angle subtended by the shower particles at the lower surface of the radiator was 6°. With this arrangement the shower curve shows 2 prominent maxima at 1·3 cm. and 18·5 cm. of Pb. Author.

383. Radio echoes and cosmic-ray showers. P. M. S. Blackett and A. C. B. Lovell. *Proc. Roy. Soc. A*, **177,** *pp.* 183–186, *Jan.* 10, 1941.—[Abstr. 293B (1941).]

FLUORESCENCE & PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

384. Certain constitutional factors controlling visible fluorescence in compounds of the benzopyrone group. S. Rangaswami and T. R. Seshadri. *Proc. Indian Acad. Sci. A*, **12,** *pp.* 375–380, *Oct.*, 1940.—The fluorescence of a large number of coumarin derivatives has been investigated. The essential requirement for the production of fluorescence by these compounds is the presence of a hydroxyl group in the 7-position. The fluorescence is the property of ions, since it is shown in alkaline or acid solution but not in neutral solution. The intensity of the fluorescence is considerably greater in alkaline than in acid solution. Unlike coumarin, coumaric acid shows feeble fluorescence in alkaline solution but not in H_2SO_4. This is considerably intensified by the presence of traces of Hg in the compound. Fluorescence in the flavone, isoflavone and chromone series, is widely met with in H_2SO_4 but not in alkaline solution. The fluorescence of the flavones does not seem to depend on the presence of a hydroxyl group; the presence of a large number of such groups has an inhibitory effect. The effect of alkyl and acyl groups on the fluorescence of chromones and flavones has also been investigated. A. J. M.

385. Fluorescence analysis. VII and VIII. H. Gotô. *Sci. Rep. Tôhoku Univ.*, **29**, *pp.* 446–476, *Nov.*, 1940.—Rhodamine B is applied to iodometry, bromometry and permanganometry, and fluorescein to bromometry as fluorescence indicators. The best conditions for titration are established, under which the estimation in coloured solutions is also carried out.

The fluorescence tests applied to the detection of cations were studied by spectrograph and the structures of the fluorescence spectra are shown photographically. Author.

386. Quantitative capillary luminescence analysis. F. E. E. Germann and J. W. Hensley. *J. Phys. Chem.*, **44**, *pp.* 1071–1081, *Dec.*, 1940.—The experiments described in this paper show the feasibility of the application of the methods of capillary luminescence analysis to the quantitative determination of concentrations, within certain limits, of very dilute solutions of fluorescent substances. The solutions may contain one or more solutes. Although both the width and the height of the band increase with increasing concentration, the most reliable measure of concentration is total fluorescence energy which is proportional to the area under the curves. At higher concentrations the crystals may become so large that the light energy is no longer proportional to the concentration. In this case the material to be tested may be diluted until concentration is proportional to fluorescence energy. The data obtained by means of the new fluorometer, using a quartz-capillary mercury vapour lamp and photronic cell, appear to be very reliable. Authors.

INTERFERENCE, DIFFRACTION AND SCATTERING.

***387. Silica gauge for measuring thickness by means of interference colours.** K. B. Blodgett. *Rev. Sci. Instrum.*, **12**, *pp.* 10–14, *Jan.*, 1941.—Details are given of the construction of a gauge for measuring the thickness of monomolecular films by means of the interference of light. The intensity of monochromatic light reflected from a thin film of a transparent material varies with the thickness of the film according to a cosine curve. When light strikes a film at an angle of incidence $i = 15°$, the variation of the log of the intensity with thickness is greatest at thicknesses $0{\cdot}75\lambda/4n$ and $1{\cdot}282\lambda/4n$, where n is the refractive index of the film. In order to bring the thickness to this critical value a silica film was developed on lead glass by treating the glass with HNO_3. Monolayers of various substances can be deposited on top of the silica film and the thickness of the monolayer determined from the change in intensity of reflected light produced by the added thickness. The change of intensity can be determined very accurately by a method of measuring the " match angle " at which 2 steps of different thickness reflect light of equal intensity. When this angle can be measured with an accuracy of ± 10′ the thickness of the added monolayer is known with an accuracy of ± 0·76 Å. Equations are given for calculating thickness. Author.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

388. Photosynthesis with radioactive carbon. II. Chemical properties of intermediates. S. Ruben, M. D. Kamen and W. Z. Hassid. **III. Ultra-centrifugation.** S. Ruben, M. D. Kamen and L. H. Perry. **IV. Molecular weights.** S. Ruben and M. D. Kamen. *J. Amer. Chem. Soc.*, **62**, *pp.* 3443–3455, *Dec.*, 1940.—The light and dark assimilation of C^*O_2 reported previously [Abstr. 2057 (1939)] on higher plants has been studied in detail in the unicellar green alga *Chlorella*. The characteristics of the time course of the C^*O_2 uptake are described. Simultaneous measurements on the rate of CO_2 reduction by the Warburg manometric method and the radioactive technique give identical rates within the experimental error. It is concluded that exchange reactions account for little of the C^*O_2 reduced; practically all must be photosynthesis. The effects of various inhibitors have been studied. The light and dark C^*O_2 reductions show the same sensitivity as normal photosynthesis to these widely different modes of injury. The dark assimilation is reversible and apparently independent of the chlorophyll concentration. No radioactive carbon was found in formaldehyde (or other volatile substances).—Using radioactive carbon as an indicator the sedimentation velocity constant of the radioactive molecule(s) in the light and dark has been found to have an average value of $7{\cdot}0 \times 10^{-14}$.—The mol. wt. of the first detectable products formed has been found to be approximately 1000. A tentative theory on the mechanism of photosynthesis is presented. Authors.

389. Hypersensitization of the latent image at high intensity by a uniform low-intensity light exposure. I. G. S. Moore. *Photogr. J.*, **81**, *pp.* 27–32, *Jan.*, 1941.—Details are given of experiments on the hypersensitizing of various Ilford emulsions by fogging (subsequent to exposure) with light of low intensity. Increases of threshold speed of the order of 2–4 times are obtained with but slight reduction in contrast. The magnitude of the speed increase is governed by the intensity of the fogging light and by the degree of development. Thus the speed increases with the time required to reach a given fog value, reaching a max. for an exposure time of 30 min. The hypersensitizing effect appears to be independent of the colour of the fogging light and is not obtained when the low-intensity fogging precedes the high-intensity camera exposure. The spectral sensitivity of panchromatic emulsions is unaffected by this method of sensitizing. A. H.

390. Mechanism of photographic development. III. Developing and non-developing reducing agents. T. H. James. *Commun. No.* 782 *Kodak Res. Lab. J. Amer. Chem. Soc.*, **62**, *pp.* 3411–3415, *Dec.*, 1940.—[See Abstr. 755 (1940)]. The rate of formation of metallic Ag in a solution of the $AgSO_3$ complex is markedly increased by the addition of colloidal Ag or $CuSO_4$, and is dependent upon the Ag-ion concentration. Na stannite reduces the Ag thiosulphate complex without Ag catalysis. A definite Ag catalysis is observed in the reduction of the AgI complex ion by stannite. Desylamine and furoin reduce Ag ion without Ag catalysis and at rates approximately equalling those of the reactions with oxygen. The significance of these results for photographic development theory is discussed. Author.

391. Elimination of hypo from photographic images. J. I. Crabtree, G. T. Eaton and L. E. Muehler. *Commun. No.* 780 *Kodak Res. Lab. J. Franklin Inst.*, **230**, *pp.* 701–725, *Dec.*, 1940.—The various factors which affect the rate of fading of images and the washing-out of hypo from films and papers are outlined. A new hypo eliminator is recommended consisting of 2 volatile chemicals, H_2O_2 and NH_3. This eliminator oxidizes the hypo to Na_2SO_4, which is inert and soluble in water, while any excess eliminator evaporates on drying. Two formulae and treatments are proposed: (1) Complete elimination of hypo for use by the professional, advanced amateur, and photofinisher. (2) Almost complete elimination of hypo (less than 0·01 mg./in^2.). Since the conditions to which prints will be subjected are rarely known in advance, use of the complete elimination treatment is advised in all cases. Authors.

POLARIZATION.

392. Optical anisotropy of molecular crystals. I. Nitta. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. C*, **7**, 1939.—[Abstr. 1555 (1940).]

REFLECTION, REFRACTION AND DISPERSION.

393. Formulae for natural dispersion of organic liquids. W. J. G. Beynon. *Phil. Mag.*, **31**, *pp.* 1–12, *Jan.*, 1941.—Natural dispersions of various alcohols from 0·67 to 0·30 μ can be represented by formulae of the type $n^2 - 1 = b_0 + \sum_r \{b_r/(\lambda^2 - \lambda_r^2)\}$, where n is the refractive index for wavelength λ and b_0, b_r and λ_r are constants, λ_r being identified with the extreme ultra-violet absorption bands of the substances in the vapour state. The values of the constants for the various liquids are given. From this and earlier work it is possible to calculate the values of e/m for the different resonators responsible for the dispersions. The values of e/m indicate that the electron is the resonator, but in all cases the calculated values are much lower than the accepted value for the electron, whilst for every liquid the value of e/m increases with increasing frequency. A. H.

***394. Direct-reading measuring microscope.** J. E. Sears, Jr. and A. Turner. *J. Sci. Instrum.*, **18**, *pp.* 17–19, *Feb.*, 1941.—The article describes a travelling microscope designed for measuring by direct readings Debye-Scherrer X-ray powder photographs. With this instrument measurements are made by direct reference to a glass scale which can be traversed, together with the photographic film, beneath a low-power microscope in which both the scale and film can be viewed together. A fixed vernier, also of glass, is viewed at the same time and readings may be made to 0·01 mm. The scale and film are traversed by hand, enabling rapid movements to be made throughout the length of the film. A fine traverse is provided for adjusting the film image to the cross-wire in the microscope. Author.

***395. Simple method for refractive-index determinations.** S. M. Cox. *J. Sci. Instrum.*, **18**, *pp.* 20–21, *Feb.*, 1941.—A method is described whereby refractive indices may be measured within about ½% accuracy, using glass rods which may be prepared by heating in the flame without the necessity of grinding or polishing. Author.

SPECTROSCOPY.

396. Sources of inaccuracy which may arise in spectrographic analysis of aluminium alloys. A. G. Quarrell and G. E. A. Bramley. *J. Inst. Met.*, **67**, *pp.* 25–47, *Jan.*, 1941.—Sources of inaccuracy which were encountered in an attempt to develop a solution method for the spectrographic analysis of alloys are also liable to occur in the more usual direct sparking method and are therefore considered in detail. Spectrum lines with abnormal densities are likely to occur when an emulsion of extreme contrast, subject to stress marking, is used, and also when the plate shows drying marks. Experiments to determine the most suitable emulsion suggested that more consistent results should be obtained by developing for a longer time than is usual. Characteristic curves obtained with the aid of a mercury vapour lamp showed that the straight-line region is more restricted than is generally supposed and, further, that satisfactory compensation can be achieved over a larger range by plotting the difference in photometer deflection between the internal standard and unknown alloy, instead of the log ratio. Finally, it is suggested that the characteristic of each photographic plate should be obtained with the aid of a mercury vapour lamp, and the advantages of this method are discussed. AUTHORS.

397. Spectro-chemical methods for assay of minerals, and applications to gold ores. K. TOISHI. *Sci. Pap. Inst. Phys. Chem. Res. Tokyo, No.* 996, *pp.* 87–99, *Nov.*, 1940.—To overcome the effect of segregation, which can cause serious errors in the analysis of ores, the finely crushed ore is allowed to run through the flame of a horizontal arc. The averaging effect thus produced has enabled work to be carried out with concentrations as low as 6×10^{-6} g. gold/g. of ore, but the accuracy of the method is only sufficient to give the order of the concentration. In an attempt to improve upon the sensitivity a magnetic field is used to spread out the flame so that particular regions may be used. It is considered that the sensitivity is improved sufficiently to permit of the detection of 1×10^{-6} g./g. A. H.

398. Satellite lines in atomic spectra and the excitation of electrons from closed shells. TA-YOU WU. *Phys. Rev.*, **58**, *pp.* 1114–1115, *Dec.* 15, 1940.—The following quantities have been calculated:—energy states in the 2 and 3 electron spectra of the atoms from Li to F; the cross-sections of the processes of (i) simultaneous ionization and the excitation of an electron from a closed shell, and of (ii) excitation from a closed shell, for Li; and the ratios of the transition probabilities for some of these states. The results are applied to the satellite lines observed by Edlén and Tyrén (*Nature*, **143**, *p.* 940, *June* 3, 1939) on the long wavelength side of the lines $1s^2\,{}^1S - 1snp\,{}^1P$, $1s\,{}^2S - 2p\,{}^2P$ in the spectra C V and C VI, respectively, good agreement being obtained between observed and calculated wavelengths on the basis of the transitions proposed. C. B. A.

399. Atomic energy levels of d^2p and d^8p configurations. T. YAMANOUCHI. *Proc. Phys.-Math. Soc. Japan*, **22**, *pp.* 841–846, *Oct.*, 1940.—The formulae for the energies of these configurations are worked out in full, a simplified method being used for constructing the relevant matrices. The formulae involve 8 parameters and good agreement with 18 observed terms of Ti II $3d^24p$ and Ni II $3d^84p$ is obtained by a suitable choice of the parameters. G. C. McV.

400. Band spectrum of the BN molecule. A. E. DOUGLAS AND G. HERZBERG. *Canad. J. Res. A*, **18**, *pp.* 179–185, *Dec.*, 1940.—In a discharge through He with traces of BCl_3 and N 2 new band systems (a triplet system and a singlet system) were found which are shown to be due to the BN molecule. The first system represents a ${}^3\Pi - {}^3\Pi$ transition similar to the Swan bands of the C_2 molecule with which BN is iso-electronic. A vibrational and rotational analysis of this system is carried out and yields the formula for the heads: $\nu_H = 27\,775{\cdot}8 + (1\,302{\cdot}6\ v' - 14{\cdot}9\ v'^2) - (1\,502{\cdot}3\ v'' - 12{\cdot}3\ v''^2)$ and the B and α values and internuclear distances: $B_e' = 1{\cdot}555$, $B_e'' = 1{\cdot}666$, $\alpha' = 0{\cdot}010$, $\alpha'' = 0{\cdot}025$, $r_e' = 1{\cdot}326$, $r_e'' = 1{\cdot}281$. An analysis of the singlet system has not as yet been possible. AUTHORS.

401. Absorption spectra of complex metallic salts of 2, 2′-dipyridyl. IV. K. YAMASAKI. *Bull Chem. Soc. Japan*, **15**, *pp.* 461–465, *Nov.*, 1940. *In German.*—The absorption spectra of $[Fe(Dip)_3]Cl_2$, $[Fe(Dip)_2(CN)_2]$, $[Fe(Dip)(CN)_4]K_2$, $[Fe(CN)_6]K_4$ and $[Fe^{III}(Dip)_3]Cl_3$ are investigated. Substitution of CN for dipyridyl causes regular displacement of the bands, and the molecular extinction coefficients of the specific bands of the diphenyl radicals are proportional to the number of such radicals present in the molecules. [*See* Abstr. 2806 (1940).] C. B. A.

402. Absorption spectra of co-ordination compounds. IV. Ethylenediamine cobaltic complexes. H. KUROYA AND R. TSUCHIDA. *Bull. Chem. Soc. Japan*, **15**, *pp.* 427–439, *Oct.*, 1940.—Absorption spectra of a number of ethylenediamine cobaltic complex salts have been observed. Generally speaking, their absorption bands, especially the second, are more hypsochromic than those of the corresponding ammine salts. The results confirm the author's hypothesis. [Abstr. 4132 (1938).] Examples of the third absorption bands have been found in the diethylenediamine cobaltic complexes of known configurations. A new method of separating $[Co\ en_3]^{3+}$ and $[Co\ en_2Cl_2(\tfrac{1}{6})]^+$ has been devised. AUTHORS.

403. Absorption spectra of Eu ion in some hydrated salts. F. H. SPEDDING, C. C. MOSS AND R. C. WALLER. *J. Chem. Phys.*, **8**, *pp.* 908–918, *Dec.*, 1940.—The absorption spectra of crystalline $EuCl_3{\cdot}6H_2O$, $EuBr_3{\cdot}6H_2O$ and $Eu_2(SO_4)_3{\cdot}8H_2O$, were photographed at various temperatures in the visible and ultra-violet region of the spectra.

The salts were found to have low-lying excited levels at about 300 cm^{-1}., 390 cm^{-1}., 938 cm^{-1}., 970 cm^{-1}. and, perhaps, 430 cm^{-1}., which arose from excited electronic, crystal and vibrational frequencies. These levels are discussed in relation to existing theories of specific heat, magnetic susceptibility, etc., of Eu. AUTHORS.

404. Raman spectra of some esters of di-carboxylic acids. B. D. SAKSENA. *Proc. Indian Acad. Sci. A*, **12,** *pp.* 416–426, *Oct.*, 1940.—The Raman spectra of oxalic acid, ethyl and methyl oxalates, oxalyl chloride, ethyl malonate, ethyl phthalate, ethyl maleate and ethyl fumerate, are studied and their state of polarization determined. The fundamental frequencies of oxalic acid and oxalyl chloride have been calculated on the *trans* model. The Raman spectrum of oxalic acid shows satisfactory agreement with this model; but the results of oxalyl chloride indicate an oscillation about the *trans* configuration. The spectrum of methyl oxalate shows striking changes while passing from the solid to the liquid state, which is probably due to a change in the C = O force, resulting from a change of the methyl group (R). AUTHOR.

***405. Technical requirements in determination of absorption spectra by ultra-violet microscope.** P. A. COLE AND F. S. BRACKETT. *Rev. Sci. Instrum.*, **11,** *pp.* 419–427, *Dec.*, 1940.—To overcome the difficulties and limitations of earlier methods for obtaining absorption spectra of detailed microstructures it has been found necessary to impose more rigid demands upon the monochromator and to introduce improvements in densitometry. The optical properties of the microscope and the spectral properties of the source together determine the requirements which must be satisfied by the monochromator. These requirements are analysed and a convenient method of quantitative densitometry described, together with the results of a simple test of this method. AUTHORS.

406. Collimated light beams in spectrophotometry. G. O. LANGSTROTH, W. W. BROWN AND K. B. NEWBOUND. *Canad. J. Res. A*, **18,** *pp.* 186–192, *Dec.*, 1940.—Theoretical analysis has predicted that considerable variation is permissible in the distance between the linear light source (a slit) and the collimating lens comprising a commonly used spectrophotometric system. This prediction has been tested experimentally over a wide range of source-to-lens distances. The results are in accord with the theoretical expectation. AUTHORS.

VISION.

407. Sequence illusion. R. L. IVES. *J. Franklin Inst.*, **230,** *pp.* 755–763, *Dec.*, 1940.—When all the lights of a linear series are illuminated simultaneously, they appear, to a casual observer, to be illuminated in sequence, that nearest the observer being perceived first. This sequence illusion is explained by application of well-known physical and physiological principles, and its importance as a factor in certain observations of natural phenomena is discussed. AUTHOR.

HEAT.

CALORIMETRY.

408. Gaseous heat capacity and restricted internal rotation of diborane. F. STITT. *J. Chem. Phys.*, **8,** *pp.* 981–986, *Dec.*, 1940.—The heat capacity of gaseous diborane has been measured from 95° to 324°K. with the low-pressure thermal conductivity apparatus described earlier [Abstr. 2565 (1939)]. The bracketing method was applied over most of this temperature range, with acetylene and ethylene as comparison gases. At 95°K. ethylene and ethane were used as comparison gases and the accommodation coefficient ratios were assumed to be unity. The heat capacity at low temperatures indicates that internal rotation in the diborane molecule is restricted by a potential barrier whose height is probably between 4000 and 6000 cal./mole if the barrier is assumed to be a sinusoidal function of the internal rotational angle. AUTHOR.

409. Low-temperature gaseous heat capacities of certain C_3 hydrocarbons. G. B. KISTIAKOWSKY, J. R. LACHER AND W. W. RANSOM. *J. Chem. Phys.*, **8,** *pp.* 970–977, *Dec.*, 1940.—The low-pressure thermal conductivities of allene, propylene, propane, methyl acetylene and cyclopropane, have been measured over the temperature range 150° to 340°K. The heat capacities derived from these measurements are compared with those from other sources. Data are presented in support of the bracketing method for deriving heat capacities from heat conductances. Heats of certain hydrogenation reactions, when calculated to 0°K. and to the non-vibrating state, are found to exhibit the same regularities as the experimental values determined at 335°K. AUTHORS.

CONDUCTION.

410. Heat conductivity of ZnO. H. F. Johnstone, H. G. Jacobson and G. W. Preckshot. *Industr. Engng Chem.*, **33**, *pp.* 106–107, *Jan.*, 1941.

DILATATION.

411. Thermal expansion of electrolytic chromium. P. Hidnert. *Bur. Stand. J. Res. Wash.*, **26**, *pp.* 81–91, *Jan.*, 1941.—The linear thermal expansion of 2 samples of electrolytic Cr was investigated at various temperatures between − 105° and + 715°C. During the first heating or heatings, when H presumably was being evolved, the samples contracted in an irregular manner. After a few heatings, however, the irregularities disappeared and smooth expansion curves were obtained. It appears also that the linear thermal expansion of electrolytic Cr, when it is first heated, may be affected by variables such as the temperature, time and rate of heating, previous treatment, etc. The following equations were derived for the length, L_t, at any temperature, t, between − 100° and + 700°C. and for the coefficient of expansion, a_t, at any temperature, t, between − 75° and + 650°C.: $L_t = L_0\{1 + (5{\cdot}88t + 0{\cdot}007\,74t^2 - 0{\cdot}000\,003\,88t^3)\,10^{-6}\}$ and $a_t = (5{\cdot}88 + 0{\cdot}015\,48t - 0{\cdot}000\,011\,63t^2)\,10^{-6}$. The density of the sample of electrolytic Cr containing 99·3% of Cr increased 2·4% and the volume decreased 2·3% after 3 cycles of heating to 500°C. and cooling to room temperature. The length decreased 1·1%. Author.

FUSION AND SOLIDIFICATION.

See Abstract 304.

TEMPERATURE.

∗412. Improved radiation pyrometer. T. R. Harrison and W. H. Wannamaker. *Rev. Sci. Instrum.*, **12**, *pp.* 20–32, *Jan.*, 1941.—In designing a new radiation pyrometer for industrial use above the lower limit of visible radiation, consideration of ambient temperature effects, which is of much importance in modern industrial practice, was carried out by aid of mathematical analysis. In one hypothetical case, with a very sensitive type of thermopile losing heat from its hot junction by radiation alone, it is shown that an increase in operating ambient temperature of 180 deg. F. (from 80°F. to 260°F.) results in a drop in output voltage of 38% for a constant furnace temperature of 1 300°F. The corresponding error in reading is 315°F. The constancy of ratio of e.m.f.'s shown for higher conduction factors makes it possible to provide ambient temperature compensation over a wide range of furnace temperatures with a Ni shunt compensator. The pyrometer here described shows ambient temperature errors of less than 3 deg. F. in the furnace temperature being measured for ambient temperature variations from 50° to 200°F.; transient errors would usually be 1 deg. or less for most cases; the response is complete within 3·5°F. in 4 sec. and within ½ deg. or less in 6 sec. The calibration, with varying ratios of distance-to-target *v.* target diameter up to over 20 to 1, is unusually constant. A thermopile of 10 units insures ample e.m.f. All of the thermopile junctions are spot-welded and the construction is arranged throughout to withstand high ambient temperatures. Authors.

THERMOCHEMISTRY.

413. Fire-extinguishing effectiveness of chemicals in water solution. H. D. Tyner. *Industr. Engng Chem.*, **33**, *pp.* 60–65, *Jan.*, 1941.—Results are presented of over 800 tests on wood cribs to measure the fire-extinction effectiveness of water solutions of 33 chemical compounds in various concentrations, and the results of similar tests with water alone. The study indicates the advantages that may be obtained by adding chemicals to the water used. Results of several other investigators are reviewed. Author.

414. Latent energy and dissociation in flame gases. W. T. David, A. S. Leah and B. Pugh. *Phil. Mag.*, **31**, *pp.* 156–168, *Feb.*, 1941.—The gases remaining after flame has spread through an inflammable gaseous mixture are not just hot normal gases. The view has been put forward [Abstr. 2184 (1937)] that they contain a considerable latent energy which, in the absence of surface, persists for a long time and varies in amount with the conditions of the mixture before combustion. The latent energy probably resides in a proportion of the tri-atomic molecules, formed during combustion, as an excess of intra-molecular energy which cannot be handed on to the translational degree of freedom. The experimental evidence, collected over a period of years, is reviewed in Part I of this paper—the attention being confined to mixtures of CO and air. In Part II experiments are described which show that there is a much larger dissociation in flame gases than in normal gases of the same composition under similar conditions of temperature and pressure. This would appear to result from the excess of intra-molecular energy in the tri-atomic molecules, and the experiments indicate that the extent of the abnormal dissociation varies with the latent energy. Authors.

415. Ignition of inflammable gases by hot moving particles. II. S. Paterson. *Phil. Mag.*, **30,** *pp.* 437–457, *Dec.*, 1940.—This paper is a continuation of previous work [Abstr. 3371 (1939)]. The technique was modified so as to enable lower speeds (1·2 m./s.) to be used. The ignition temperatures of 10% and 20% coal gas and air mixtures, of 10% H_2-air mixtures and of 3% pentane-air mixtures were studied and found to vary with the diameter of the sphere causing the ignition and with the composition of the mixture. The effect of the substance of the sphere was investigated and, except in the case of Pt, appears to be of secondary importance. A slight deterioration can be observed with quartz spheres. The theoretical aspect of the problem is discussed. G. G.

THERMODYNAMICS.

416. Bose-Einstein condensation. T. Nagamiya. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7,** 1939.—[Abstr. 4623 (1939).]

417. Thermodynamic study of bivalent metal halides in aqueous solution. VII. The activity coefficient of barium bromide at 25°. R. A. Robinson. *Trans. Faraday Soc.*, **37,** *pp.* 82–84, *Feb.*, 1941.—An isopiestic determination of the activity coefficient of $BaBr_2$ at 25°C. has shown that $BaBr_2$ gives an activity coefficient curve considerably higher than that of $BaCl_2$, and that no reversal in order of the chloride and bromide occurs. In this respect the Ba salts are unlike the Rb and Cs salts. Author.

418. Activity coefficients of gases. Calculation from the Beattie-Bridgeman equation of state. S. H. Maron and D. Turnbull. *Industr. Engng Chem.*, **33,** *pp.* 69–72, *Jan.*, 1941.—The Beattie-Bridgeman equation is employed to derive an equation for the activity coefficients of gases as functions of pressure and temperature. The equation is applied to the calculation of the activity coefficients of N, H and NH_3. The calculated results are compared with the activity coefficients for these gases obtained graphically. The agreement is shown to be satisfactory over a wide range of pressure and temperature. It is further shown how the derived equation may be utilized to obtain K_y values for gaseous equilibria as analytic functions of pressure and temperature. Applied, for example, to the NH_3 equilibrium, the equation for K_y gives good agreement with published values for this thermodynamic function. Authors.

419. Thermodynamics of films: energy and entropy of extension and spreading of insoluble monolayers. W. D. Harkins, T. F. Young and E. Boyd. *J. Chem. Phys.*, **8,** *pp.* 954–965, *Dec.*, 1940.—The thermodynamic relations of insoluble monolayers on a mobile sub-phase are given and equations are presented for their increase of entropy, heat absorbed, increase of heat content and increase of internal energy, during expansion. Two different methods of expansion are considered: in spreading, the decrease of area of the sub-phase is equal to the increase of area of the monolayer; in extension, the monolayer expands but the area of the clean surface of the sub-phase remains constant. The 2-dimensional phases are classified as gas, liquid expanded, intermediate or transition, liquid condensed, and solid. Beginning with a 2-dimensional liquid in its most condensed condition, the mean molecular distances may be increased by 60% without destruction of the liquid state. This is very different from what is found in 3 dimensions [Abstr. 3168 (1939)]. The heat absorbed in the melting of the 2-dimensional solid is zero, so this is phase change of the second order. The increase in heat content when the monolayer spreads over unit area is several hundred ergs/cm^2. for a solid film. The increase of heat content for the other 2-dimensional phases are illustrated by data for pentadecylic acid. H. H. Ho.

420. Entropy of dilution of strong electrolytes in aqueous solutions. H. S. Frank and A. L. Robinson. *J. Chem. Phys.*, **8,** *pp.* 933–938, *Dec.*, 1940.—The relative partial molal entropy of water, $\bar{S}_1 - S_1^0$, in aqueous electrolyte solutions is calculated from existing data. An attempt is made to correlate these values with changes in the structure of water in the solutions. It is found that cations of small radii and ions capable of forming H bonds with the water, such as H_3O^+, OH^- and NH^+_4, help to stabilize the water structure, while large ions and ions of non-spherical and non-tetrahedral shapes have an effect in the opposite direction. In dilute solutions the entropy of dilution depends largely on the ionic strength. In all cases deviations from the Debye-Hückel limiting law are positive. Authors.

See also Abstract 305.

ACOUSTICS.

421. Velocity of sound. R. C. COLWELL, A. W. FRIEND AND L. H. GIBSON. *J. Franklin Inst.*, **230,** *pp.* 749–754, *Dec.*, 1940.—A new method for measuring the velocity of sound over short distances has been devised in which 60 pulses per sec. cause a sinusoidal curve to appear upon an oscilloscopic screen. As the receiving microphone is moved away from the sound oscillator, the crest of the sine curve moves across the oscilloscope, completing the circle in 1/60 sec. The actual velocity of the sound is easily calculated after the distance moved by the microphone has been measured. Application of the probability laws and the error curve shows that the method is very accurate, providing the frequency of the a.c. supply is constant at 60 c./s. AUTHORS.

422. Effect of temperature on the ultrasonic velocity in liquids. V. SURYAPRAKASAM. *Proc. Indian Acad. Sci. A*, **12,** *pp.* 341–349, *Oct.*, 1940.—Using the method based on the diffraction of light by ultrasonic waves, the sound velocities and the adiabatic compressibilities of 11 organic liquids have been determined at various temperatures in the range of 30° to 120°C. Three of the liquids stated had been investigated earlier by Tyrer, who used a piezometer, and by Freyer, Hubbard and Andrews, who used a sonic interferometer. Their results agree with those obtained by the author. All the liquids exhibit a diminution of sound velocity with rising temperature, the rate being of the order of 3 to 5 m./sec./deg. AUTHOR.

423. Vibration of metallic discs by the rhythmic sublimation. T. OKAYA AND T. TOBIISI. *Coll. Pap. Fac. Sci., Osaka Imp. Univ. B*, **7,** 1939.—[Abstr. 1891 (1940).]

***424. Supersonic oscillator.** B. H. PORTER. *Industr. Engng Chem.* (*Analytical Edition*), **12,** *pp.* 748–749, *Dec.* 15, 1940.—After enumerating some of the uses of supersonic waves in industrial chemistry a short account is given of a suitable oscillator and rectifier. The latter furnishes 1 100 V d.c. to the oscillator, which uses 2 Western Electric tubes in a simple push-pull circuit with a tapped tank coil to enable the output to be varied. The quartz crystal used is approximately 3·44 cm. diameter and has a thickness corresponding to a frequency of 512·56 kc./s. at 24°C. The crystal sits on a lead block forming one electrode, the other electrode resting lightly on the upper face and being connected by 4 flexible copper straps to a concentric ring supported on insulating pillars. Common insulating oil is a useful immersion fluid, the height of the surface above the crystal face being regulated to give an optimum fountain head. A. W.

***425. Improved sound level meter.** W. MIKELSON. *Gen. Elect. Rev.*, **43,** *pp.* 515–517, *Dec.*, 1940.—This comprises a non-directional microphone carried on a flexible arm on the instrument case, a 5-stage valve amplifier, an indicating instrument calibrated in db, a variable attenuator acting as a range selector, and a calibrating device. Calibration is done from a reference level of 10^{-16} W/cm^2., with a range of from 24 to 130 db. The indicator is marked $-$ 4 to $+$ 10 in steps of 1 db and the attenuator has steps of 10 db. The output may be taken off to telephones or to a cathode-ray oscillograph. Calibration is performed by blowing a special whistle near the microphone; the sound level is fixed and independent of blowing pressure. The instrument is portable; applications are given. E. H. W. B.

426. Effect of application of sonic energy to the hydrolysis of potassium persulphate. W. C. SCHUMB AND E. S. RITTNER. *J. Amer. Chem. Soc.*, **62,** *pp.* 3416–3420, *Dec.*, 1940.—The rate of hydrolysis was studied at 25°, 60° and 70°, with the application of sonic energy, using improved apparatus. When purely thermal effects were balanced out and any possible catalytic effect of metallic Ni was eliminated, the application of sound energy was found to result in an increase in the reaction rate. The monomolecular *k* with applied sound energy was found to increase with increased time of vibration, with increased concentration of persulphate and with increased volume. The effect of sound energy was found to be too small to be measured conveniently at 25°. At 60° and 70° a definite increase in reaction rate was observed which, expressed as a fractional increase in *k*, was perhaps slightly smaller at 70°. AUTHORS.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

427. Ozone in silent electric discharge. W. H. OTTO AND W. H. BENNETT. *J. Chem. Phys.*, **8,** *pp.* 899–903, *Dec.*, 1940.—Ozone is produced in silent discharges in air by collisions intermediate between ionizing energies and attaching energies, due to the dissociation of oxygen molecules into atoms by electrons. A more detailed mechanism for the silent discharge is given. AUTHORS.

DIELECTRICS AND CAPACITANCE.

428. Electric moments and relaxation times of protein molecules. J. L. ONCLEY. *J. Phys. Chem.*, **44**, *pp.* 1103–1113, *Dec.*, 1940.—The electric moments of serum albumin, serum pseudoglobulin-γ and edestin, were found to be about 380, 1 200 and 1 400 Debye units, respectively. These large electric moments are of considerable importance in the interpretation of the inter-action of these molecules. A study of the dielectric dispersion of these molecules gave relaxation times and shapes which are compared with those from diffusion, ultra-centrifuge and viscosity measurements. The agreement was good in the case of serum albumin and edestin without the assumption of any very large degree of hydration, but in the case of the serum pseudoglobulin-γ it appeared necessary to assume a moderate amount of hydration or some other complicating phenomenon. AUTHOR.

429. Dipole moments and resonance in the tetronic acids. W. D. KUMLER. *J. Amer. Chem. Soc.*, **62**, *pp.* 3292–3295, *Dec.*, 1940.—The dipole moments of 5 tetronic acids and 2 esters have been determined in dioxane solution. As a result of a comparison with the calculated moments it is concluded that: (1) the compound is chiefly in the enol form in dioxane solution; (2) a resonating form involving a separation of charge contributes to the structure of the molecule; (3) the hydroxyl group is fixed in the plane of the ring with the hydrogen of the hydroxyl oriented toward the α-carbon atom. The resonating forms of 1,3-diketones, β-ketonic esters and β-ketonic γ-lactones are discussed. AUTHOR.

ELECTROCHEMISTRY.

430. Anomalous concentration cell. L. R. ALLISON, E. J. HARTUNG AND E. HEYMANN. *J. Phys. Chem.*, **44**, *pp.* 1033–1037, *Dec.*, 1940.—The potential Sn/Sn^{++} in SnCl$_2$ solutions of various concentrations has been investigated. $dE/d\log c$ is much smaller than the Nernst value (29LmV). This is due to the breaking-up of complex ions into simple ions on dilution. Addition of HCl makes the potential much more negative. Obviously the amount of complex ions, e.g. SnCl$_4^{--}$ or SnCl$_3^-$, is greatly increased at the expense of stannous ions. The potential Sn/Sn^{++} in strongly acid solutions of SnCl$_2$ varies linearly with the log of the analytical concentration of SnCl$_2$, $dE/d\log c$ being very near to the Nernst value. This is due to the stabilizing effect of HCl on the complex, which makes it insensitive to dilution. The activity of the remaining stannous ions, which determines the potential, is then roughly proportional to the analytical concentration of the salt. The nature of the complex ions present in acid SnCl$_2$ solutions is discussed. AUTHORS.

431. Combination of silk fibroin with acid and with base. L. F. GLEYSTEEN AND M. HARRIS. *Bur. Stand. J. Res. Wash.*, **26**, *pp.* 71–79, *Jan.*, 1941.—A study was made of the dependence on *p*H of the amounts of HCl and of KOH that are taken up by silk fibroin at 0°C. The effect of added KCl on this dependence was also investigated and was shown to be the binding of an increased quantity of acid or base at a given *p*H. The maximum acid-combining capacity of silk fibroin is 0·13 milli-equivalent/g.; the maximum base-binding capacity is greater than 0·90 milli-equivalent/g. The presence of 0·13 to 0·17 milli-equivalent of free carboxy groups in silk fibroin is estimated from the titration curve. The great amount of base bound can be accounted for only if the phenolic hydroxyl groups of tyrosine take part in the equilibria with base. Further evidence that these groups bind base is provided by the greatly decreased amount of base bound by methylated fibroin. AUTHORS.

432. Determination of hydrogen-ion concentration. *Engineering*, **151**, *pp.* 21–23, *Jan.* 10, *and pp.* 64–65, *Jan.* 24, 1941.—[Abstr. 236B (1941).]

***433. A.C. powered *p*H set.** C. W. GOODWIN. *Science*, **92**, *pp.* 587–588, *Dec.* 20, 1940.—The changes of e.m.f. which reflect the changes of *p*H are recorded by an a.c. powered current amplifier possessing a high input impedance. In the present design there is a regulating transformer, a gaseous discharge tube and push-pull connections. A cascade circuit gives ample isolation with no critical parts. The elimination of batteries without loss in stability should prove a convenience. H. H. HO.

See also Abstract 341.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

434. Secondary electron emission of Ni at the Curie point. P. S. VARADACHARI. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 381–390, *Oct.*, 1940.—A study of the secondary electron emission from Ni has been made at different temperatures ranging from 30°–470°C. at certain definite applied potentials. No sudden alteration in the secondary electron current was observed at the Curie point (358°C.). These results are at variance with those of Tartakowsky and Kudrjawzewa and of Hayakawa. Attention is drawn to the investigations of Rao wherein no abrupt variations were obtained in the photo-electric emission and soft X-ray excitation curves of Ni at the Curie point. AUTHOR.